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To: People in Need of Environmental Security (PINES)
From: Mark Hutson
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Date: September 19, 2007

Subject: Larry Jensen's Radiological Data Review

Several of the comments and questions provided by Larry Jensen on the radiological aspects of the Yard 520 site characterization bring up issues that we will persue with USEPA. For purposes of clarification, each of Larry's comments and questions are copied below along with our notes about the issues.

**Sampling site selection** – The text does not describe how the 10 sampling sites were selected. Were they equally spaced over the site? Were they selected statistically? Were they selected for special characteristics? Or was there another rationale?

> *The rationale used to select locations for collecting samples for radionuclide analyses were provided in a separate document entitled "Yard 520 Sampling and Analysis Plan" dated September 2005. In that document the respondents proposed collecting samples only from the south area of Yard 520 to avoid the potential of sampling non-coal combustion waste materials that could be encountered in the North Area. " Five samples were located in the far western portion of the South Area to capture pre-1992 CCBs (high sulfur); five additional samples were located in the remaining portion of the South Area (low sulfur). In each of these areas, the five samples were placed on a triangular grid."*

**Sampling Methodology** – The test does not describe how samples were taken.

When the samples were taken, was it from an upper soil layer or deeper down? Generally USEPA Region 5 bases soil cleanup levels on the concentration in 15 centimeter (6 inch) depths. In field surveys, the maximum soil concentration at each sampling site is required. To find the depth of maximum radionuclide concentration, USEPA usually drills a borehole into the contaminant. Then a gamma scintillometer (measuring gamma-ray count rate) is lowered down the hole to determine count rate as a function of depth. Finally a 15 centimeter long soil sample is taken at the depth of maximum count rate.

When the samples were taken, was soil collected from a wide shallow layer, from a narrow deep hole, of by some other method? How much soil was collected (1 quart, 500 grams, something else)? Were grass, sticks, stones removed and the soil sifted or was the sample composed of everything taken from the hole? Generally not removing objects will bias the concentration low. Was the sample homogenized? This is a very critical action so that the aliquot is not biased high or low. Was a smaller aliquot taken from a larger, homogenized, aliquot?

*A description of sampling methods was provided in the 2005 Yard 520 Sampling and Analysis Plan. Sampling methods for samples collected within Yard 520 were described as follows: "All CCB borings from within the Type III (South) Area of Yard 520 will be continuously cored to a depth of 12 feet below ground surface (bgs). CCB samples from the 8 to 12-foot depth interval will be submitted for laboratory analysis. This depth range should be well within the area where CCBs were deposited within the Type III (South) Area of Yard 520 below cover materials and above lower liner(s). Samples from the 8 to 12-foot depth interval will be homogenized (see ENSR SOP No. 7116Pines) then placed in laboratory-supplied containers."*

*Sampling methods for samples collected from background locations were described as follows: "Surface soil samples will be collected from 25 background locations where suspected CCBs are not known to be present. At each location, the soil material will be inspected to ensure suspected CCBs are not present. If suspected CCBs are present at the sample location, the sample location will be relocated. Soil samples will be logged for descriptive purposes, and laboratory samples will be collected at a depth of 0 to 6 inches bgs. Surface litter, such as leaves and roots, will be removed from the sample. Soil will be homogenized then placed in laboratory-supplied containers. Additional volume will be also be collected (approximately 1 to 2 liters in volume) and retained and may be used for later visual inspection and chemical/physical analysis, if needed."*

It does not appear a field duplicate was taken. That would have been a valuable sample for quality control purposes.

*Sample number GP008ICB092305D is a field duplicate of sample number GP008ICB092305S.*

**Analytical Methodology** – The test does not describe analytical methods.

*Analytical Methods were described in the Quality Assurance Project Plan (QAPP) that was submitted by the Respondents as an appendix to the Sampling and Analysis Plan.*

When samples were received at a lab were they dried or were samples analyzed as they arrived? Wet samples will result in a lower measured concentration.

*The laboratory Standard Operating Procedure for soil sample preparation was not included with the QAPP. We will ask USEPA for clarification of this question.*

What method was used for analysis (gamma spectroscopy, radiochemistry. fluoroscopy, something else?)? The quality of data will depend upon the method.

*The laboratory methods used were gamma spectroscopy and alpha spectroscopy, both by Method HASL 300.*

What were the detection limits? Generally, detection limits should have been low enough to measure background levels. If the detection limits were too high the usability of the data may be lost.

*The plan Minimum Detectable Activity (MDA) for each radionuclide is specified in Table A-5 of the QAPP. Actual MDA is calculated for each analysis and was not reported with the data. We will ask USEPA for clarification of this issue.*

Were two aliquots taken from the same sample and both measured (for quality control)? Were there samples measured and then the same sample measured (for quality control)? The report text does not discuss duplicates. Table 4 shows a duplicate for GP008 but does not describe the type of duplicate.

*The QAPP specifies that laboratory duplicates, matrix spikes and matrix spike duplicates be prepared and analyzed by the laboratory in addition to analyzing the field duplicate that was collected along with the samples. Results of these analyses are generally reviewed during data validation to verify that the data are usable for their intended use.*

**Background Measurements** - Background data should have been taken from additional samples in the vicinity of Yard 520. The fundamental strategy for background samples is to select collection sites where the soil is as nearly like the soil of concern but assuredly without any contamination. Use of a national average background is inappropriate because local backgrounds can vary higher or lower. Inappropriate backgrounds can lead to either false positive or false negative conclusions.

That said, data in Table 6 under Background is reasonable for common soils and rocks.

*The Sampling and Analysis Plan specifies that background samples from local soils would be collected and analyzed for use in comparing CCW samples to local background. However, the report of results only discusses national average background values. We will ask USEPA for clarification of why the national averages were used rather than local background values, and what the results of the background sampling showed.*

**Data Quality Judgements** - Most data in Table 4 is to three digits. However, some data is only to two digits (e.g., Uranium-234 for GP008) or to one digit (e.g., Actinium-227 for GP009). My feeling is that all this data was originally expressed with three digits but was inadvertently rounded to less on the spreadsheet. Data in Table 4 should be reported to the digits reported from the lab.

For background soils, and contaminated soils containing unprocessed natural radionuclides, one fundamental way to judge if the data has been analyzed well is to review the data and see it the concentrations for each of the three natural radiation series, Uranium (U-238), Thorium (Th-232) and Actinium (U-235) are in equilibrium (each radionuclide concentration in the series has the same numerical value.) Data for GP004-GP013 were grouped by series and are shown in attached Table 1. Some data is acceptable (e.g., Th-232 Decay Series for GP005 which varies from 2.56 – 2.63 picocuries per gram (pCi/g)) and some data is of low quality (e.g., U-238 Decay Series for GP009 which varies from 4.77- 6.81 pCi/g).

*We will forward this comment to USEPA for their review and response.*

**Section 4.1.1 Background Evaluation** – The closing statement "…radionuclide concentrations present in CCBs collected from Yard 520 are generally within the range of background levels present in the environment" is not supported by the data in table 4 and Table 5. This data was combined in the attached Table 1 where it can be seen that GP004-GP013 data (Table 4) has a range of about 2-7 times background (Table 5).

*We will forward this comment to USEPA for their review and response.*

**Section 4.1.2 Human Health Risk Screen Results –** USEPA Region 5 has done risk assessments for radionuclides. These have been done by multiplying USEPA risk-concentration factors for individual radionuclides (from Federal Radiation Guidance documents) times the measured concentration (less background), adding all risks, and comparing these to the Superfund (National Contingency Plan) risk range of $10^{-6}$ to $10^{-4}$. Risk found this way is excess risk, which is the proper focus for risk decisions. That process should be applied to this data set. In this way, there will be no need to convert risk to annual dose for comparison to the 15 millirem/year dose guideline.

Risks should not be judged for individual radionuclides but by the summed risk for all radionuclides present.

Also, for cleanups, USEPA Region 5 has largely relied upon the total radium standards in Title 40, Part 192 of the Code of Federal Regulations where 5 pCi/gplus background is used as the cleanup criterion for successive 15 centimeter depths below ground. Total radium is defined as the concentration for radium-226 plus the concentration for radium-228. From Table 1 the total radium background is 1pCi/g + 0.87pCi/g, respectively. Added to 5 pCi/g, this would be a cleanup guideline of 6.87 pCi/g for this site. In Table 1, sites GP007 and GP009 exceed this criterion. An actual cleanup level for this site cannot be determined until local background levels far at least radium-226 and radium-228 are measured.

*We will forward this comment to USEPA for their review and response.*

**Section 4.2 Literature Review** - Data presented in this report does not support the assertion that radioactivity in coal fly ash is comparable to radioactivity in background soils and rocks. Background levels for the primary radionuclides (those in the U-238 and Th-232 decay series) are about 1 pCi/g (Table 5) while measured levels in the GP004 – GP013 data (Table 4) are about 2 – 7 times this. If this GP data is considered to be from coal combustion products than there is a definite elevation over background as shown in the attached Table 1.

We will forward this comment to USEPA for their review and response.

Table 1 – Background Data and Data for Sites GP004 through GP013

| | U-238 Decay Series (pCi/g) | | | | | | Th-232 Decay Series (pCi/g) | | | | U-235 Decay Series | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **U-238** | **U-234** | **Th-230** | **Ra-226** | **Pb-210** | **Po-210** | **Th-232** | **Ra-228** | **Th-228** | **Ra-226 + Ra-228 (pCi/g)** | **U-235** | **Pa-231** | **Ac-227** | **U-NAT** | **U-238** | **U-235** |
| Background Table 6 | 0.96 | 0.96 | 0.96 | 1 | 1 | NA | 0.87 | 0.87 | 0.87 | 1.87 | 0.007 | | | 2.1 | 2.1 | 2.1 |
| | | | | | | | | | | | | | | | | |
| GP004 | 2.53 | 2.55 | 2.19 | 2.19 | 2.13 | 2.13 | 1.59 | 1.41 | 1.53 | 3.6 | 0.272 | 0.107 | 0.0952 | 6.1 | 6.1 | 0.045 |
| GP005 | 2.86 | 3.66 | 3.23 | 3.23 | 3.22 | 3.22 | 2.56 | 2.59 | 2.63 | 5.82 | 0.238 | -0.642 | 0.289 | 10.4 | 10.4 | 0.075 |
| GP006 | 4.14 | 3.94 | 3.49 | 3.49 | 4.21 | 4.21 | 2.85 | 3 | 2.92 | 6.49 | 0.246 | -0.475 | -0.0537 | 11.1 | 11 | 0.079 |
| GP007 | 4.17 | 4.71 | 4.22 | 4.22 | 5.61 | 5.61 | 3.14 | 2.87 | 3.21 | 7.09 | 0.337 | -0.598 | 0.0474 | 14 | 13.9 | 0.099 |
| GP008 | 3.1 | 3.49 | 3.06 | 3.08 | 2.1 | 2.1 | 2.28 | 2.29 | 2.34 | 5.35 | 0.146 | 0.175 | 0.0408 | 14.6 | 14.5 | 0.11 |
| GP008 | 2.2 | 3.4 | 3.25 | 3.25 | 4.55 | 4.55 | 2.37 | 2.52 | 2.42 | 5.77 | 0.282 | -0.637 | -0.0341 | 12.9 | 12.8 | 0.093 |
| GP009 | 4.77 | 5.38 | 4.63 | 4.63 | 6.81 | 6.81 | 2.79 | 2.63 | 2.85 | 7.26 | 0.347 | -0.57 | 0 | 14.1 | 14 | 0.1 |
| GP010 | 3.79 | 3.95 | 3.4 | 3.4 | 2.81 | 2.81 | 2.58 | 2.58 | 2.85 | 5.96 | 0.223 | 0.298 | 0.0565 | 9.8 | 9.7 | 0.07 |
| GP011 | 2.58 | 2.65 | 2.43 | 2.43 | 2.88 | 2.88 | 2.03 | 2.17 | 2.07 | 4.6 | 0.203 | 0.442 | 0.0985 | 7.4 | 7.3 | 0.0561 |
| GP012 | 2.62 | 3.68 | 3.23 | 3.23 | 2.27 | 2.27 | 2.07 | 2.12 | 2.13 | 5.35 | 0.267 | 0.772 | 0.0479 | 10.5 | 10.4 | 0.075 |
| GP013 | 2.3 | 2.06 | 1.7 | 1.7 | 1.55 | 1.55 | 1.53 | 1.49 | 1.56 | 3.19 | 0.0774 | -0.205 | -0.0503 | 8.5 | 8.5 | 0.06 |